

Progress Report - 1986

Predator Control to Enhance the Production of
Greater Sandhill Cranes on
Malheur National Wildlife Refuge

Malheur National Wildlife Refuge
Harney County, Oregon

by

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EXECUTIVE SUMMARY

The nesting population of greater sandhill cranes on Malheur National Wildlife Refuge, Oregon has declined from 236 pairs in 1971 to 181 pairs in 1986. Nesting studies conducted from 1966 to 1986 have repeatedly demonstrated that the primary limiting factor for cranes nesting on Malheur Refuge is the predation of eggs by ravens, raccoons and coyotes, and the predation of prefledged chicks by coyotes.

On 21 January 1986, Malheur Refuge staff assisted by U.S. Department of Agriculture (Animal and Plant Health Inspection Service) employees began controlling predators on approximately 27,000 acres (14%) of Malheur Refuge. Control efforts ceased on 18 August, the end of the crane fledging period.

One hundred sixty-six coyotes were removed by the following methods: aerial gunning (51%), trapping and snares (27%), calling and shooting (19%), and denning (3%). An estimated 44 ravens were removed, using 44 dozen chicken eggs injected with DRC-1339. Eleven raccoons were removed, 10 by hunting with dogs and one was caught in a snare.

Overall crane production was 50 chicks, the highest count since 1970. Recruitment of crane chicks in the predator control area was 14.9%, the highest ever recorded on the refuge. In the non-predator control area, the recruitment rate was 54% below the 16-year average of 6.4%. The 1986 nesting data compared to prior years' studies, strongly suggests that approximately 17-18 additional crane chicks reached flight stage that would not have survived without predator control. Additional nesting studies of Canada geese and ducks also showed major increases in nesting success in the predator control areas.

The objectives of the 1986 effort was to have a nesting success 75%, fledging success 25% and recruitment 15% in the predator control area. the actual outcome was 70%, 29.9% and 14.9% respectively. Based on these results, the 1986 predator control effort was judged a success. It is recommended that control efforts for 1987 be expanded to include all the key crane nesting areas on the refuge (85,000 acres) as outlined in the 25 November Environmental Assessment entitled: "Alternatives to Enhance the Production of Greater Sandhill Cranes on Malheur National Wildlife Refuge, Oregon".

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1. When the original EA was issued, Animal Damage control (ADC) was a division of the U.S. Fish and Wildlife Service, Department of Interior. Since then, the ADC branch was transferred to the Department of Agriculture and is now known as APHIS (Animal and Plant Health Inspection Service). In this report, ADC and APHIS are synonymous.

I. INTRODUCTION

On 25 November 1965, the U.S. Fish and Wildlife Service (USFWS) issued a final environmental assessment entitled "Alternatives to Enhance the Production of Greater Sandhill Cranes on Malheur National Wildlife Refuge, (MNWR), Oregon". This assessment, herein known as the "EA", outlined a 21% decline in breeding pairs of sandhill cranes on MNWR from 236 in 1971 to 186 in 1985. The primary cause for this decline was low recruitment of young due to high nest predation by ravens, raccoons, and coyotes, and high predation by coyotes on chicks before fledging. In an average year, predators destroyed 45% of all crane nests on the refuge before they hatched and 85% of the chicks that hatched failed to fledge.

The EA proposed that efforts to improve sandhill crane nesting habitat continue and in addition, that coyotes, ravens, and raccoons would be controlled during 1986 on approximately 27,000 acres (14%) of MNWR.

The purpose of the control efforts was to: 1) increase sandhill crane nesting success to 75%, fledging success to 25%, and annual recruitment to a minimum of 15% on a sustained basis; 2) reach refuge production objectives of 150 crane chicks annually, and 3) reverse the current downward trend in the refuge crane population so they could ultimately be removed from Region I's Sensitive Species List.

Predators were to be controlled by refuge and APHIS personnel. An estimated 250 coyotes were to be removed the first year by the following methods: aerial gunning (75%), denning (10%), trapping and snares (8%), and calling and shooting (7%). An estimated 120 ravens were to be removed the first year, using chicken eggs injected with DRC-1339 (3-chloro P-toluidine hydrochloride), a toxicant that is highly selective to corvids. An estimated 50 raccoons were to be removed the first year by shooting (60%) and trapping (40%).

The EA outlined that if the proposed action proved successful in the first year, the area of control would be expanded to include approximately 85,000 acres (46% of the refuge) for the second and third years. Complete evaluation and reassessment of the control efforts would be conducted after the three-year study. Annual progress reports would be written and circulated to all interested parties. The following summarizes the results of the 1986 efforts.

II. METHODS

Predator control methods included aerial gunning, calling and shooting, trapping, snares, and denning for coyotes; DRC-1339 egg baits for ravens; and trapping and shooting for raccoons. Greater sandhill crane and waterfowl nesting and production was monitored. Each method is discussed as follows:

A. Predator Control

1. Aerial gunning was conducted, using a low level fixed-wing airplane (Cessna Supercub) during early morning hours. Although the EA called for 4 hours of helicopter flights, the helicopter was not used because we believed the airplane was providing sufficient control throughout the season.

Initial control was done, using twelve-gauge shotguns with No.4 lead buckshot. Early in the control efforts, the USFWS issued guidelines and implementation schedules for the use of steel shot for hunting waterfowl. At that time, Harney County was scheduled to be a steel shot zone for the fall 1986 waterfowl season. Harney County has since been changed and is now scheduled to be a steel shot zone by 1991. However, since the proposal was made to include Harney County in a steel shot zone, the decision was made to immediately convert aerial gunning operations to steel shot.

APHIS personnel were provided with several boxes of steel BB's in twelve gauge for use on the refuge. Steel BB's were tested extensively, both on and off the refuge, by APHIS personnel and proved inadequate. This load did not provide the quick, humane killing impact that is characteristic of the No.4 lead buckshot loads. Thus, steel shot use was suspended and lead was used for the remainder of the season.

2. Trapping was used for both raccoons and coyotes and was done solely by APHIS personnel. Off-set traps were used with fetid scent baits. Non-target species were released unless they were too stressed or injured, in which case, they were dispatched with a small caliber firearm. All traps were set out of direct view from the refuge public access roads. Concealed live traps were used to trap raccoons along waterways that were open to public fishing. These were used to avoid any possible conflicts with fishermen or their pets.

Traps were checked on a daily basis during the March-May period. From June to 18 August, traps were checked daily from Monday through Friday, due to a switch in personnel.

3. Snares were used for both coyotes and raccoons. Operational criteria for snares was basically the same as traps, except that fetid scents were not used with snares.
4. Calling and shooting was conducted by APHIS and refuge personnel and involved coyotes only. Coyotes were called, using a variety of calls (howlers, squeakers, etc.), and shot with scope-mounted rifles.

5. Denning was used at active dens and involved the placement of a gas cartridge in the den itself. The den entrance was covered with dirt and the cartridge consumed the oxygen in the den, killing the pups by suffocation. Denning involved coyotes only.
6. Dogs were used primarily to hunt raccoons at night. The dogs cornered or treed the raccoons, which were shot with small caliber firearms by APHIS personnel. Dogs were also used to locate adult coyotes near den sites. Adult coyotes near den sites react strongly to the pressure of dogs by either howling, barking, or chasing the intruding dog from the den area. It is an effective technique used to locate active dens.
7. DRC-1339 Egg Baits were used strictly for raven control. The chemical was injected into domestic chicken eggs at the rate of 1 ml of a 10% solution per egg. Three or four treated eggs were placed conspicuously in "dummy" nests to simulate natural nests. Dummy nests were monitored daily and consumed eggs were replaced until the target ravens were removed, usually within a few days.

B. Nesting Studies

1. Sandhill Cranes. Sixty crane nests were located in the Blitzen Valley; 30 in the predator control area and 30 outside. The first nest was located on 15 April and the last on 13 June. Most nests were re-examined approximately 30 days after discovery and fates of nests determined by egg shell remains and other evidence found at each nest.

Beginning in late August and continuing until mid-September, young cranes were counted on grainfields and the number of young produced was determined. The procedures for nesting studies (20 years) and fall chick counts (16 years) have been followed on the refuge and data collection is consistent with past methodologies.

2. Waterfowl. Nesting data is routinely collected on MNWR for ducks and Canada geese, to determine nesting success. This information is used to estimate overall waterfowl production on the refuge. In 1986, fates were determined on 123 Canada goose and 82 duck nests on MNWR. These nests were generally located early in incubation and revisited approximately 30 days later to determine fates.

Table I. Summary of Coyotes Taken by all Methods On Malheur NWR, Harney County, Oregon
January 21 to August 18, 1986

<u>Month</u>	<u>Number of Coyotes Removed - by Method</u>						<u>Total by Month</u>
	<u>Aerial Gunning</u>	<u>Calling- Shooting</u>	<u>Traps</u>	<u>Snares</u>	<u>Denning</u>	<u>Live Traps</u>	
January	25	3	0	0	0	0	28
February	30	7	0	0	0	0	37
March	1	5	2	1	0	0	9
April	6	4	7	1	5	0	23
May	6	8	1	1	0	0	16
June	4	0	7	0	0	0	11
July	13	3	13	0	0	0	29
August	<u>0</u>	<u>1</u>	<u>12</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>13</u>
Totals	85	31	42	3	5	0	166

Grand Total - - - 166

Table 2. Summary of Coyotes Removed by Aerial Gunning on Malheur NWR,
Harney County, Oregon, 1986

<u>Date</u>	<u>Hrs. Flown</u>	<u>Hrs. Hunt</u>	<u>No. Coyotes Killed</u>	<u>Coyotes per hour of Hunting</u>
01/23	1.6	0.3	4	13.3
01/24	3.3	2.3	21	9.1
02/07	2.4	1.4	30	21.4
03/05	4.1	1.0	1	1.0
04/28	4.5	3.0	3	1.0
04/29	1.9	0.9	3	3.3
05/09	2.2	1.2	2	1.7
05/19	3.5	2.5	4	1.6
06/16	2.6	1.6	4	2.5
7/18	2.9	1.9	7	3.7
07/31	<u>2.7</u>	<u>1.7</u>	<u>6</u>	<u>3.7</u>
	31.7	17.8	85	4.8

Table 3. Summary of Trapping Activity in the Predator Control Area, 1986

	<u>Equipment in Field</u>				<u>Number of Trap Nights</u>		
	<u>#Days</u>	<u>Traps</u>	<u>Snares</u>	<u>Live Traps</u>	<u>Traps</u>	<u>Snares</u>	<u>Live Traps</u>
<u>March</u>							
03/08-03/15	7	29	13	0	203	91	0
03/16-03/22	7	39	29	0	273	203	0
03/23-03/29	7	54	38	0	378	266	0
03/30-03/31	2	53	33	0	106	66	0
Monthly Total	23				960	626	0
<u>April</u>							
04/01-04/05	5	60	36	0	300	180	0
04/06-04/12	7	64	33	0	448	231	0
04/13-04/19	7	52	25	0	364	175	0
04/20-04/26	7	42	14	0	294	98	0
04/27-04/30	4	42	14	0	168	56	0
Monthly Total	30				1574	740	0
<u>May</u>							
05/01-05/02	2	32	14	0	64	28	0
05/03-05/10	7	25	12	0	175	84	0
05/11-05/17	7	25	10	0	175	70	0
05/18-05/24	7	23	8	0	161	56	0
05/24-05/29	6	14	4	0	84	24	0
05/29	All equipment pulled on 05/29				--	--	0
Monthly Totals	29				659	262	0
<u>June</u>							
06/01-06/06	6	15	0	0	90	0	0
06/07-06/13	7	49	0	0	343	0	0
06/14-06/20	7	49	1	1	343	7	0
06/21-06/27	7	52	1	1	364	7	7
06/28-06/30	3	52	1	1	156	3	7
Monthly Totals	30				1296	17	14
<u>July</u>							
07/01-07/04	4	52	1	3	208	4	12
07/05-07/11	7	60	1	3	420	7	21
07/12-07/18	7	61	1	3	427	7	21
07/19-07/25	7	61	1	3	427	7	21
07/26-07/31	6	61	1	3	366	7	18
Monthly Totals	31				1848	32	93
<u>August</u>							
08/01	1	58	0	3	58	0	3
08/02-08/08	7	55	0	3	385	0	21
08/09-08/15	7	55	0	3	385	0	21
08/16-08/18	3	55	0	3	165	0	9
Monthly Totals	18				993	0	54
Season Totals	161				7,330	1,677	1,161

Table 4. Non-target Species Caught, Released, and/or Killed on Malheur NWR during Trapping Activities, March 8 - August 18, 1986

<u>Species</u>	<u>Total No. Caught</u>	<u>No. Released</u>	<u>No. Killed</u>
Porcupine	24	20	4
Badger	10	9	1
Canada Goose	1	1	0
Bobcat	2	1	1
Beaver	1	1	0
	38	32	6

IV. RESULTS

A. Predator Control

1. Coyotes: Coyote control work began on 21 January 1986, when a single animal was shot from the ground by APHIS personnel. The last coyotes were removed on 18 August, when 3 were taken in traps. During this period, a total of 166 coyotes were removed by all methods (Table 1).

Aerial gunning accounted for 51% of all coyotes taken. The aerial gunning activities are summarized in Table 2. The difference between total hours flown and total hours hunted represents commuting time from the Burns airport to the refuge and back again. Of the 85 coyotes killed from the plane, 6 were shot off-refuge. These animals were originally located on the refuge, but during the aerial pursuit, ran off the refuge before they could be killed.

Trapping accounted for 25% of all coyotes taken and snares, 2%. Trapping and snaring activity is summarized in Table 3. Of the 42 coyotes taken in traps, three were taken off-refuge at sites immediately adjacent to the refuge boundary fence. Trapping accounted for 60% of all coyotes taken during the June-August fledging period.

Calling and shooting accounted for approximately 19% of the coyotes taken. Two of the 31 coyotes taken by this method were shot off-refuge.

Denning with gas cartridge was used only once in 1985. A litter of five pups was removed by this method on 28 April. One of the adults at this den was shot from the airplane and the other from the ground.

2. Raccoons

A total of 11 raccoons were taken, all on the refuge. One animal was caught in a snare and ten were killed using dogs and shooting. Nine of the raccoons were taken between 24-25 March and two were taken on 28 April.

3. Ravens

The exact number of ravens killed is unknown because of the manner in which DRC-1339 affects the bird. Typically, the chemical takes 24 to 48 hours to kill a raven. During this period, the bird becomes very secretive and often flies away from the area where the egg was consumed and dies.

In 1985, there were 5 known active raven nests in the predator control area and vicinity. One of these pairs was removed, using DRC-1339. The other 4 pairs were on peripheral sites away from the key crane nesting areas.

These pairs were not removed. One pair was known to fledge 6 young.

Between 4 March and 30 June, 44 dozen bait eggs were placed in the predator control area, in crane nesting areas frequented by ravens. Since the local breeding population was known to be small (5 known pairs), it is presumed that most of the ravens in question were either non-breeders or migrants that were passing through and hunting in the predator control area.

It is estimated that 1 raven was removed for each dozen eggs placed in the control area. Total estimated raven kill was 2 breeding adults and 42 non-breeder/migrants.

Only 4 dead ravens were found or reported in the control area and vicinity. Necropsies were not performed on any of these birds because of the advanced stage of decomposition. All of these birds are presumed to have died from DRC-1339 ingestion.

4. Non-Target Mortalities

Table 4 summarizes all non-target mortalities associated with this year's trapping efforts. The only unanticipated non-target species caught in a trap was one Canada goose which stepped in a coyote trap placed on a dike top used as a coyote trail. The goose had no broken bones, so it was released and flew away.

The only other non-target mortalities associated with this year's control efforts involved consumption of DRC-1339 bait eggs. The EA estimated that 5 black-billed magpies, 2 California gulls, and 2 ring-bill gulls would be taken as non-target mortalities from DRC-1339. No dead magpies or gulls were found in the predator control area; however, there is reason to believe that at least some non-target mortality took place. Therefore, for lack of any data, these estimates will remain standing.

B. Sandhill Cranes

The fates of sandhill crane nests is summarized in Table 5. Although the nesting success in the predator control area (70%) was slightly below the objective level of 75%, it was the highest nesting success recorded on the refuge since nesting studies began in 1966 (see Table 1 of EA, page 8). The overall nest loss to predation of 20% in the control area was also the lowest ever recorded since 1966. The two infertile nests within the predator control nest sample kept overall nest success below the 75% objective level.

Nest success in the non-predator control area was 63%, slightly less than the 70% in the predator control area.

Table 5. Fates of 60 Greater Sandhill Crane Nests Monitored During the 1986 Nesting Season

<u>Fate</u>	<u>Number of Nests (Percent)</u>	
	<u>Predator Control</u>	<u>Non-Predator Control</u>
Successful:	21(70%)	19(63%)
Unsuccessful:		
Abandoned	1(3)	1(3)
Infertile	2(7)	0
Predation	6(20)	10(33)
Common Raven	1(3)	1(3)
Raccoon	1(3)	1(3)
Coyote	1(3)	
Unknown	3(10)	8(27)
	30	30

Total loss to predators was 33%, below the 20-year average of 45%. Most of the nest losses in the unknown predator category are believed to be coyotes, because they commonly will remove eggs from the nest site, leaving no egg shell remains or other evidence to determine the predator involved.

The combined nest success for control and non-control areas was 67%, which ties the record reached in both 1974 and 1982. Experimental predator control was conducted on the refuge in 1982.

Table 6 summarizes fledging success and recruitment rates for the predator control area, non-control area, and the refuge as a whole. In the predator control area, the fledging success objective (25%) was exceeded (29%). The recruitment rate in the control area (14.9%) was slightly below the objective level of 15%, but it was the highest rate ever recorded on the refuge.

Recruitment in the non-control area was 5.4%, which is below the 16 year refuge average of 6.4% (Table 7). Recruitment for the entire refuge was 12.1%, the highest since 1970, the last year predator control was conducted on the refuge (Table 7), other than the experimental efforts of 1982 and 1983. Over-all production was 50 young, likewise the highest count since 1970.

Considering that overall nesting success for the refuge was 67% and the average clutch size was 1.85, 77.6% of the young died between hatching and fledging (Table 8). This pre-fledge chick mortality was the lowest since 1978.

C. Other Nesting Studies

Sampled Canada goose nest fates are summarized in Table 9. Nesting success for Canada geese in the predator control area was 70%, versus 47% outside the control area.

Sample nest fates for ducks is summarized in Table 10. Dabbling duck nesting success in the control area was 82%, versus 25% in the uncontrolled area. Diving duck nesting success in the control area was 100%, versus 67% outside.

IV. DISCUSSION

A. Predator Control

1. Coyotes - In 1986, 166 coyotes were removed from MNWR and adjacent area. This is less than the 250 estimated in the EA. A major factor in this reduced harvest was that in 1986, coyote populations in Harney County were down considerably. According to the coyote population index

Table 6. Comparison of Nesting Success, Fledging Success, and Recruitment Rates for the Predator Control and Non-Predator Control Area, Malheur NWR, Harney County, Oregon, 1986

	Objective Level	Predator Control Area (77 Pairs)	Non-Predator Control Area (53 Pairs)	Refuge Total (181 Pairs)
Nesting Success	75%	70%	63%	67%
Fledging Success (broods/pairs)	25%	29.9%	9.4%	22.7%
Recruitment Rate	15%	14.9%	5.4%	12.1%

Table 7. Fall Recruitment (percent young in total population) of Greater Sandhill Cranes at Malheur NWR, Oregon 1970-1986

Year	No. Young Fledged	Percent Recruitment
1970	68	12.5
1971	46	8.9
1972	43	8.3
1973	2	0.4
1974	2	0.4
1975	17	3.5
1976	47	9.1
1977	27	5.8
1978	43	8.9
1979	39	8.1
1980	34	7.1
1981	23	5.0
1982	25	5.5
1983	39	8.4
1984	8	1.8
1985	9	2.4
1986	50	12.1
Average	31	6.4

Table 8. Percent Young Greater Sandhill Crane Mortality from Time of Hatching to Time of Fledging

Year	Percent Young Mortality
1970	66.5%
1971	80.7%
1973	98.0%
1974	98.8%
1976	84.6%
1977	85.5%
1978	70.1%
1980	84.9%
1981	88.7%
1982	90.1%
1983	84.8%
1984	93.9%
1985	92.6%
1986	77.6%
Average	85.5%

Nesting studies were not conducted in 1972, 1975, and 1979.

Table 9. Summary of Canada Goose Nest Fates on Malheur National Wildlife Refuge, Oregon 1986

Fate	<u>Number of Nests (Percent)</u>	
	<u>Predator Control Area</u>	<u>Non-Predator Control Area</u>
Successful	30(70%)	38(47%)
Unsuccessful:		
Abandoned	6(14%)	4(5%)
Predation		
Avian Predator	5(12%)	6(8%)
Mammalian Predator	2(4%)	23(29%)
Unknown Predator	0	9(11%)
	<hr/> 43(100%)	<hr/> 80(100%)

Table 10. Summary of Duck Nesting Success on Malheur National Wildlife Refuge, Harney County, Oregon 1986

	<u>Percent Nesting Success (n)</u>	
	<u>Predator Control Area</u>	<u>Non-Predator Control Area</u>
Dabbling Ducks	82%(33)	25%(40)
Cinnamon Teal	88%(8)	9%(11)
Northern Shoveler	67%(6)	0%(4)
Mallard	75%(8)	33%(12)
Northern Pintail	67%(3)	0%(1)
Gadwall	100%(8)	42%(12)
Diving Ducks	100%(3)	67%(6)
Redhead	100%(2)	59%(4)
Canvasback	100%(1)	100%(2)

(see p.21 of EA), developed by Oregon Department of Fish and Wildlife biologists for the Harney County area, coyote numbers in the early spring of 1986 were 65% of normal, based on long-term (1942-1986) census data. Thus, from a local perspective, the refuge entered the 1986 nesting season with considerably lower coyotes numbers than when the EA estimates were made.

Coyote control efforts in 1986 were intense, but by no means total. Throughout the spring-summer period, coyotes could be heard howling in the control area on any night. Day-time observations were greatly reduced, but not eliminated. It is estimated that over 90% of the resident coyotes were removed from the control area.

As was expected, most of the resident coyotes were removed early in the control efforts. For example, 55 coyotes were killed in the first 4.0 hours of aerial hunting. As coyotes entered their denning period (April-May), the coyote harvest tapered off. However, as the summer progressed, harvest increased as weaned pups and adults began to drift on the refuge from adjacent areas. This was very apparent in the trapping data. For example, in May, trapping efficiency was 1 coyote per 460 trap/snare nights. But by August, efficiency had increased to 1 per 83 trap nights.

The most efficient and cost-effective method of coyote removal was aerial gunning. The refuge was flown a total of 11 times; however, three of these flights were curtailed because of bad weather. The number of flights exceeded the estimated 4 flights outlined in the EA. Experience proved that the control area could rarely be covered well in one flight. As aerial gunning efforts were being conducted in one part of the control area, coyotes were often observed leaving the refuge in another. Thus, the procedures outlined in the EA were modified to include more flights of shorter duration. Total hours flown (31.7) was consistent with that outlined in the EA (30.0). Actual time in the air, hunting over the refuge, was 17.8 hours.

The EA called for 4.0 hr. of helicopter time to be used in aerial gunning work. It was decided not to use a helicopter because of the additional expense, and because the airplane and its crew were doing a good job of keeping coyote numbers low.

Despite the many advantages of aerial gunning, it did have major limitations late in the summer when tall lush marsh vegetation made spotting coyotes from the air almost impossible. Thus, by the end of the crane fledging period (late July-early August), aerial gunning was stopped and all the remaining coyote control was done with traps and shooting (Table 1).

Despite relatively intense control efforts prior to the denning period, there were three known active dens on the refuge in 1986. These dens were in Island, South Little Juniper, and East Grain Camp fields. The South Little Juniper den was removed with a gas cartridge on 28 April, after both adults had been shot (1 from the air and one from the ground). The East Grain Camp den was removed on 19 May, when 6 pups were shot from the ground. Both adults had been killed earlier in the day; one from aerial gunning and one in a trap. The fate of the Island Field den was undetermined. When the den site was visited on 19 May, one fresh headless pup carcass was present. Examination of the carcass indicated that it was killed by an unidentified raptor. No other pups or adults were present. This den could have been relocated to some other area.

Overall, trapping was more efficient than snares. Traps took one coyote for each 175 trap nights, whereas snares took one coyote for each 551 snare nights. The maximum number of traps used at any one time (61) exceeded that outlined in the EA (50). This decision was made following consultation between APHIS and refuge personnel. The 50 trap maximum in the EA was not a practical estimate for the size of the control area, so the use of extra traps was judged to be reasonable and within the practical limits of the EA.

In 1986, every coyote control technique outlined in the EA was used except aerial gunning by helicopter. Table 11 outlines the percent of estimated coyote kill in the EA versus actual for 1986. The actual outcome of the control efforts differed from the expected (ie. an overestimation of aerial gunning and an underestimation of the other methods). This points out the importance of having a variety of control techniques available to get the job done. For example, even though denning was used only once, in that particular instance, it was the appropriate tool to use. Coyotes rapidly returned to the refuge, once control efforts were stopped. By early September, 4 to 7 coyotes could be commonly seen in the hayed meadows of the control area on any given day from the Center Patrol Road.

2. Ravens - An estimated 44 ravens were taken by DRC-1339 in 1986, less than the 120 estimated in the EA. Total eggs used was 44 dozen, versus the 75 dozen estimated in the EA.

Eggs were placed as selectively as possible, only in those areas where ravens were observed hunting in or near crane nesting areas. Egg placement was terminated in late June, when all the sandhill cranes had completed incubation.

Egg baits were successful in reducing crane egg losses to

Table 11. Estimated Coyote Kill by Method as Outlined in the Environmental Assessment Versus Actual Kill by Method, 1986

<u>Method</u>	<u>Percent of Total Coyotes Taken</u>	
	<u>Estimated</u>	<u>Actual</u>
Aerial Gunning	75%	51%
Denning	10%	3%
Trapping and Snares	8%	27%
Calling and Shooting	7%	19%
	<u>100%</u>	<u>100%</u>

ravens. Only two of the 60 monitored crane nests were lost to ravens albeit there was no difference between the control and non-control areas. Raven predation rates in both the control and non-control areas (3%) tied the lowest rate ever recorded on the refuge (1982), a year when ravens were experimentally controlled.

3. Raccoons - Eleven raccoons were taken in 1986, 10 by hunting with dogs and 1 in a snare. This is far less than the 50 estimated in the EA.

Our experience with spring raccoon hunting showed that this technique was difficult at best. In the spring, with all of the refuge wetlands irrigated, raccoons were widely dispersed over a large area. This made locating raccoons difficult. We have since consulted with Dr. Ed Hill, USFWS, Co-operative Wildlife Research Unit, Mississippi State University, who has conducted much research on raccoons and control techniques. His recommendation was that control efforts be conducted in the fall (preferably October), when the refuge is the driest and raccoons are concentrated around the few remaining wet areas.

Raccoon control efforts were inconclusive in 1986. Although no difference could be demonstrated between crane nest losses in the control and non-control areas (1 nest lost in each area), this was probably due to the small sample size involved. In an average year, raccoons take approximately 11% of the sandhill crane nests on the refuge, so the 3% loss seen this year was an improvement.

4. Cost and Manpower - At the time the EA was written, Animal Damage Control (ADC) was part of the U.S. Fish and Wildlife Service. In the interim, ADC was transferred to the U.S. Department of Agriculture and is now known as USDA-APHIS (Animal and Plant Health Inspection Service). This move necessitated the issuance of an Interagency Agreement between USFWS and APHIS, which was finalized in June, 1986. Under this agreement, the refuge was to reimburse APHIS up to \$9,600 for aircraft rental and salaries of trappers to work in the control area during 1986.

On 2 March a temporary APHIS trapper, Jim Petersen, was hired and stationed at the south end of the control area at Camper Corral. Jim worked full-time on the control area until 30 May. On 2 June, Jim's duties were taken over by full-time APHIS employee Miles Hausner. Miles worked the control area from 2 June to 18 August, when all predator control activities were terminated. The refuge paid APHIS \$7,020 for salaries and \$2,443 for aircraft charter, for a total of \$9,463. In addition to these expenses, the refuge provided APHIS with a pick-up truck for the March-May period. The truck was driven 3,210 miles, which cost \$738 at 23 cents per mile.

- B. Sandhill Cranes - The sandhill crane breeding population on Malheur NWR in 1985 was estimated at 186 pairs, as stated in the EA. However, by 1986, the population had dropped to 181 pairs. Sandhill cranes had a good nesting season in 1986. Nesting success in the predator control area (70%) and the non-control area (63%) were well above the long term average of 49% for the refuge. In part, this is due to the removal of predators in the control area and also to the removal of predators that frequented both the control and non-control areas. Other factors that were important included a warm mild spring, which helped cranes through the incubation and hatching period, and excellent late water conditions in many areas, which improved conditions for brooding and fledging.

Fifty crane chicks were counted on the refuge in 1986, above the long-term average of 31. This is the highest count since 1970, when 68 were fledged. It is significant to note that in 1970 the refuge had 236 pairs of cranes, but only 181 in 1986.

The predator control area fledged 27 chicks in 1986, while it produced only 1 in 1985. In the non-predator control area, only 6 chicks were produced. An additional 4 fledged in the Double-0. The remaining 13 chicks counted on the refuge came from adjacent private lands in Diamond and Happy Valley. In most years, the number of chicks produced in the Diamond Valley and Happy Valley area is unknown. However, due to a statewide crane pair survey in 1986, this information was available. Fall crane counts in refuge grainfields have traditionally included Diamond and Happy Valley birds; therefore, the data in Table 7 is comparable throughout the entire period of record, although it does include cranes produced off the refuge.

In the predator control area, cranes fledged 0.35 chicks per pair. In the non-control area, the rate was 0.11 per pair, less than half of the control area.

The objectives of the predator control efforts as stated in the EA, were to attain 75% nesting success, 25% fledging success, and 15% recruitment. Two infertile nests in the 30 nest sample that was monitored in the predator control area kept nest success slightly below objective level. Otherwise, the other objectives were essentially met or exceeded.

C. Other Nesting Studies

1. Canada Goose - Canada goose nesting data in recent years has been collected infrequently. These data are summarized in Tables 12 and 13. In 1986, Canada goose nesting success in the predator control area was the highest recorded in the Upper Blitzen Valley since at least 1974. Conversely, predation rates for the Upper Blitzen Valley were the lowest.

Table 12. Summary of Canada Goose Nesting Success for Unit 1, Malheur Lake-Unit 7, Lower Blitzen Valley (Units 8 and 9), and Upper Blitzen Valley for the Years 1974, 1977, 1979, 1980, 1982, 1984, 1985, 1986

	1974	1977	1979	1980	1982	1984	1985	1986
Unit 1-Double-0	29%	23%	---	---	29%	52%	---	21%
Malheur Lake-Unit7	---	75%	---	---	58%	37%	71%	50%
Lower Blitzen Valley	36%	46%	100%	72%	52%	31%	36%	62%
Upper Blitzen Valley (Predator Control Area)	32%	51%	31%	29%	45%	11%	29%	70%

Table 13. Summary of % Predation for Double-0, Malheur Lake-Unit 7, Lower Blitzen Valley, and Upper Blitzen Valley for the Years 1974, 1977, 1979, 1980, 1982, 1984, 1985, 1986 for Canada Geese

	<u>1974</u>	<u>1977</u>	<u>1979</u>	<u>1980</u>	<u>1982</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>
Unit 1 - Double-0	71%	77%	---	---	71%	48%	---	74%
Malheur Lake - Unit 7	---	25%	---	---	42%	63%	29%	33%
Lower Blitzen Valley	64%	54%	0%	28%	48%	69%	---	38%
Upper Blitzen Valley Predator Control Area	64%	49%	69%	71%	55%	85	52%	15%

In 1986, the largest single cause of nest failure was mammalian predation. In the predator control area, mammalian predators took 2 of 46 nests (4%). In the non-predator control area, mammalian predators took 14 of 67 nests (21%).

This pattern could not be demonstrated for avian predation, however. In the predator control area, avian predators took 5 of 46 (11%), versus 4 of 67 (6%) in the Lower Blitzen Valley. These higher losses in the predator control area were probably due to migrant ravens that were able to destroy a few nests before they moved on or were removed by DRC-1339.

Ducks - Duck nest monitoring followed similar pattern as was seen with sandhill cranes and Canada geese. The 82% nesting success for dabbling ducks and the 100% success for diving ducks is unprecedented since at least 1974 (Table 10). The 25% success for dabbling ducks outside the predator control area was about average for the refuge, while the 67% for divers was slightly above average.

- D. Conflicts and Problems - Predator control efforts went very smoothly this year. There were no major problems encountered and no complaints were received. During aerial gunning operations, all public access roads were closed for safety considerations, with locked gates from approximately 6:00 AM to 9:00 AM. This caused a minor but short term inconvenience to a few refuge visitors, particularly during the peak use period (April-May). By July, there were so few early morning visitors to the refuge that the gates were not locked for the last two flights.

For the most part, control activities were done discreetly and without conflict with other refuge users, to the extent that most visitors were not even aware that it was going on.

V. CONCLUSIONS

Predator control efforts in the Upper Blitzen Valley for 1986 were a success. Our objective of 15% recruitment was essentially met with 14.9%, the highest ever recorded on Malheur NWR. Without predator control, the expected production in the predator control area, based on long-term recruitment rates (6.4%), would have been 10 chicks. However, in 1986, the predator control area produced 27 chicks. In the non-predator control area, the expected production was 7 and the actual was 6. If the predator control area had the same recruitment rate as the non-control area (5.4%), production in 1986 would have been only 9 chicks. Therefore, the data strongly suggests that predator control efforts in 1986 accounted for approximately 17-18 additional crane chicks reaching flight stage that would not have survived without predator control.

Although the 1986 predator efforts on Malheur NWR were initiated to enhance sandhill crane production, incidental nesting studies show that predator control efforts also benefited nesting waterfowl.

VI. RECOMMENDATIONS FOR 1987

1. All operational features of the 1985 EA should remain in effect and unchanged for the 1987 season, except as noted above.
2. Predator control efforts for the 1987 nesting season should be expanded as outlined in the EA, to include all key crane nesting areas (approximately 85,000 acres, 46% of the refuge).
3. Steel shot, size T, should be tested in 1987 to evaluate its efficiency in killing coyotes from the air.
4. Biological monitoring of nesting cranes should be expanded to coincide with expanded control area in 1987. To do this, the 60 nest samples should be stratified to coincide with the occurrence of nesting pairs.
5. Fall raccoon hunting should be tested in the Upper Blitzen Valley in 1986, with recommendations to follow.
6. In 1987, staggered work schedules and other time management options should be implemented to insure that the required 24-hour trap checks mandated in the EA can be maintained at all times. This will reduce some non-target mortalities associated with trapping and will be more humane for the trapped target species.
7. Trappers should be allowed to set as many traps as they feel necessary to get the job done efficiently, rather than be hindered by an arbitrary maximum.
8. The number of refuge employees authorized to control predation on the refuge during routine duties, should be increased. In 1986, only 1 employee was authorized to conduct control activities and this proved very successful. The actual number of employees authorized for 1987 should be at the refuge manager's discretion.
9. At least two refuge pick-ups (one more than we had in 1986) need to be equipped with battery operated sirens to assist in locating coyotes on the ground.